

# Unit 3: Periodic Table

## Periodic Trends Notes

### Metals vs. Nonmetals vs. Metalloids

Metals, Nonmetals, and Metalloids																		H		He											
Li		Be												B		C		N		O		F		Ne							
Na		Mg												Al		Si		P		S		Cl		Ar		metals					
K		Ca		Sc	Ti	V	Cr	Mn	Fe	Co	Ni	Cu	Zn	Ga	Ge		As		Se		Br		Kr								
Rb		Sr		Y	Zr	Nb	Mo	Tc	Ru	Rh	Pd	Ag	Cd	In	Sn		Sb		Te		I		Xe		metalloids						
Cs		Ba		La	Hf	Ta	W	Re	Os	Ir	Pt	Au	Hg	Tl	Pb		Bi		Po		At		Rn								
Fr		Ra		Ac	Rf	Db	Sg	Bh	Hs	Mt	Ds	Rg	Uub	—	Uuq		—		—		—		—		nonmetals						

# Atomic Radius (picometers)

1	<h1>Atomic Radius</h1> <p>(picometers)</p>																31	
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
2	152 ● Li	111 ● Be	Atomic radius tends to decrease in any period as the atomic number increases.										82 ● B	77 ● C	75 ● N	73 ● O	71 ● F	38 ● Ne
3	186 ● Na	160 ● Mg	Atomic radius tends to increase in any group as the atomic number increases.										143 ● Al	111 ● Si	106 ● P	102 ● S	99 ● Cl	71 ● Ar
4	227 ● K	197 ● Ca	160 ● Sc	145 ● Ti	131 ● V	125 ● Cr	137 ● Mn	124 ● Fe	125 ● Co	125 ● Ni	128 ● Cu	134 ● Zn	122 ● Ga	122 ● Ge	119 ● As	116 ● Se	114 ● Br	88 ● Kr
5	248 ● Rb	215 ● Sr	178 ● Y	159 ● Zr	143 ● Nb	136 ● Mo	135 ● Tc	133 ● Ru	134 ● Rh	138 ● Pd	144 ● Ag	149 ● Cd	163 ● In	140 ● Sn	145 ● Sb	135 ● Te	133 ● I	106 ● Xe
6	265 ● Cs	217 ● Ba	172 ● Lu	156 ● Hf	143 ● Ta	137 ● W	137 ● Re	134 ● Os	136 ● Ir	139 ● Pt	144 ● Au	150 ● Hg	170 ● Tl	175 ● Pb	154 ● Bi	167 ● Po		

## Comparing Atomic and Ionic Radii

### Cations

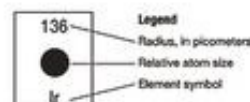
The radius of a cation is less than its atom's radius.

152 ● Li	76 ● Li <sup>+</sup>	111 ● Be	45 ● Be <sup>2+</sup>
186 ● Na	102 ● Na <sup>+</sup>	160 ● Mg	72 ● Mg <sup>2+</sup>
227 ● K	138 ● K <sup>+</sup>	197 ● Ca	100 ● Ca <sup>2+</sup>

### Anions

The radius of an anion is greater than its atom's radius.

73 ● O	140 ● O <sup>2-</sup>	71 ● F	133 ● F <sup>-</sup>
102 ● S	184 ● S <sup>2-</sup>	99 ● Cl	181 ● Cl <sup>-</sup>
		114 ● Br	196 ● Br <sup>-</sup>

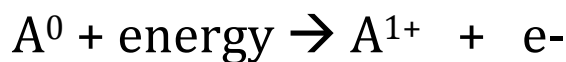


Sources:  
1. Web Elements, Bond length (a.u.)  
2. Shannon, R. D., Ion Radii (5-coordinate),  
Revised Effective Ionic Radii and Systematic  
Analysis of Interatomic Distances in Halides  
and Chalcogenides, (1976)

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Ionization Energy: Energy needed to \_\_\_\_\_  
from an atom to form a positive ion.



\*\*\*metals have \_\_\_\_\_ ionization energies

\*\*\*nonmetals have \_\_\_\_\_ ionization energies

1) amount of energy needed decreases down a family

2) amount of energy needed increases across a period

Why?:

INCREASING IONIZATION ENERGY

<div></div>																		<div></div>																																																																																																																																																																																																																																																																																																																	
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<div>11 Na Sodium 22.989770</div>																		<div>12 Mg Magnesium 24.3050</div>																		<div>13 Al Aluminum 26.981538</div>																		<div>14 Si Silicon 28.0855</div>																		<div>15 P Phosphorus 30.973761</div>																		<div>16 S Sulfur 32.066</div>																		<div>17 Cl Chlorine 35.4527</div>																		<div>18 Ar Argon 39.948</div>																																																																																																																																																																																																					
<div>19 K Potassium 39.0983</div>																		<div>20 Ca Calcium 40.078</div>																		<div>21 Sc Scandium 44.955910</div>																		<div>22 Ti Titanium 47.867</div>																		<div>23 V Vanadium 50.9415</div>																		<div>24 Cr Chromium 51.9961</div>																		<div>25 Mn Manganese 54.938049</div>																		<div>26 Fe Iron 55.845</div>																		<div>27 Co Cobalt 58.933200</div>																		<div>28 Ni Nickel 58.6934</div>																		<div>29 Cu Copper 63.546</div>																		<div>30 Zn Zinc 65.39</div>																		<div>31 Ga Gallium 69.723</div>																		<div>32 Ge Germanium 72.61</div>																		<div>33 As Arsenic 74.92160</div>																		<div>34 Se Selenium 78.96</div>																		<div>35 Br Bromine 79.904</div>																		<div>36 Kr Krypton 83.80</div>																	
<div>37 Rb Rubidium 85.4678</div>																		<div>38 Sr Strontium 87.62</div>																		<div>39 Y Yttrium 88.90585</div>																		<div>40 Zr Zirconium 91.224</div>																		<div>41 Nb Niobium 92.90638</div>																		<div>42 Mo Molybdenum 95.94</div>																		<div>43 Tc Technetium (98)</div>																		<div>44 Ru Ruthenium 101.07</div>																		<div>45 Rh Rhodium 102.90550</div>																		<div>46 Pd Palladium 106.42</div>																		<div>47 Ag Silver 107.8682</div>																		<div>48 Cd Cadmium 112.411</div>																		<div>49 In Indium 114.818</div>																		<div>50 Sn Tin 118.710</div>																		<div>51 Sb Antimony 121.760</div>																		<div>52 Te Tellurium 127.60</div>																		<div>53 I Iodine 126.90447</div>																		<div>54 Xe Xenon 131.29</div>																	
<div>55 Cs Cesium 132.90545</div>																		<div>56 Ba Barium 137.327</div>																		<div>57 La Lanthanum 138.9055</div>																		<div>72 Hf Hafnium 178.49</div>																		<div>73 Ta Tantalum 180.9479</div>																		<div>74 W Tungsten 183.84</div>																		<div>75 Re Rhenium 186.207</div>																		<div>76 Os Osmium 190.23</div>																		<div>77 Ir Iridium 192.217</div>																		<div>78 Pt Platinum 195.078</div>																		<div>79 Au Gold 196.96655</div>																		<div>80 Hg Mercury 200.59</div>																		<div>81 Tl Thallium 204.3833</div>																		<div>82 Pb Lead 207.2</div>																		<div>83 Bi Bismuth 208.98038</div>																		<div>84 Po Polonium (209)</div>																		<div>85 At Astatine (210)</div>																		<div>86 Rn Radon (222)</div>																	
<div>87 Fr Francium (223)</div>																		<div>88 Ra Radium (226)</div>																		<div>89 Ac Actinium (227)</div>																		<div>104 Rf Rutherfordium (261)</div>																		<div>105 Db Dubnium (262)</div>																		<div>106 Sg Seaborgium (263)</div>																		<div>107 Bh Bohrium (262)</div>																		<div>108 Hs Hassium (268)</div>																		<div>109 Mt Meitnerium (266)</div>																		<div>110 (269)</div>																		<div>111 (272)</div>																		<div>112 (277)</div>																		<div>113</div>																		<div>114</div>																		<div></div>																		<div></div>																		<div></div>																		<div></div>																	

INCREASING IONIZATION ENERGY

Multiple Ionization Energies:

I.E.	1 <sup>st</sup>	2 <sup>nd</sup>	3 <sup>rd</sup>	4 <sup>th</sup>
Al	577	1816	2744	11600 Kj/mole
Al <sup>0</sup>	Al <sup>1+</sup>	Al <sup>2+</sup>	Al <sup>3+</sup>	Al <sup>4+</sup>

Electron Affinity: attraction by an atom for a \_\_\_\_\_

- 1) Electron affinity decreases from top to bottom in a family
- 2) Electron affinity increases from left to right in a period

## Why?:

# INCREASING ELECTRON AFFINITY

1 <b>H</b> Hydrogen 1.00794																	2 <b>He</b> Helium 4.003
3 <b>Li</b> Lithium 6.941	4 <b>Be</b> Beryllium 9.012182																
11 <b>Na</b> Sodium 22.989770	12 <b>Mg</b> Magnesium 24.3050																

5 <b>B</b> Boron 10.811	6 <b>C</b> Carbon 12.0107	7 <b>N</b> Nitrogen 14.00674	8 <b>O</b> Oxygen 15.9994	9 <b>F</b> Fluorine 18.9984032	10 <b>Ne</b> Neon 20.1797
13 <b>Al</b> Aluminum 26.981538	14 <b>Si</b> Silicon 28.0855	15 <b>P</b> Phosphorus 30.973761	16 <b>S</b> Sulfur 32.066	17 <b>Cl</b> Chlorine 35.4527	18 <b>Ar</b> Argon 39.948

INCREASING ELECTRON AFFINITY

19 <b>K</b> Potassium 39.0983	20 <b>Ca</b> Calcium 40.078	21 <b>Sc</b> Scandium 44.955910	22 <b>Ti</b> Titanium 47.867	23 <b>V</b> Vanadium 50.9415	24 <b>Cr</b> Chromium 51.9961	25 <b>Mn</b> Manganese 54.938049	26 <b>Fe</b> Iron 55.845	27 <b>Co</b> Cobalt 58.933200	28 <b>Ni</b> Nickel 58.6934	29 <b>Cu</b> Copper 63.546	30 <b>Zn</b> Zinc 65.39	31 <b>Ga</b> Gallium 69.723	32 <b>Ge</b> Germanium 72.61	33 <b>As</b> Arsenic 74.92160	34 <b>Se</b> Selenium 78.96	35 <b>Br</b> Bromine 79.904	36 <b>Kr</b> Krypton 83.80
37 <b>Rb</b> Rubidium 85.4678	38 <b>Sr</b> Strontium 87.62	39 <b>Y</b> Yttrium 88.90585	40 <b>Zr</b> Zirconium 91.224	41 <b>Nb</b> Niobium 92.90638	42 <b>Mo</b> Molybdenum 95.94	43 <b>Tc</b> Technetium (98)	44 <b>Ru</b> Ruthenium 101.07	45 <b>Rh</b> Rhodium 102.90550	46 <b>Pd</b> Palladium 106.42	47 <b>Ag</b> Silver 107.8682	48 <b>Cd</b> Cadmium 112.411	49 <b>In</b> Indium 114.818	50 <b>Sn</b> Tin 118.710	51 <b>Sb</b> Antimony 121.760	52 <b>Te</b> Tellurium 127.60	53 <b>I</b> Iodine 126.90447	54 <b>Xe</b> Xenon 131.29
55 <b>Cs</b> Cesium 132.90545	56 <b>Ba</b> Barium 137.327	57 <b>La</b> Lanthanum 138.9055	72 <b>Hf</b> Hafnium 178.49	73 <b>Ta</b> Tantalum 180.9479	74 <b>W</b> Tungsten 183.84	75 <b>Re</b> Rhenium 186.207	76 <b>Os</b> Osmium 190.23	77 <b>Ir</b> Iridium 192.217	78 <b>Pt</b> Platinum 195.078	79 <b>Au</b> Gold 196.96655	80 <b>Hg</b> Mercury 200.59	81 <b>Tl</b> Thallium 204.3833	82 <b>Pb</b> Lead 207.2	83 <b>Bi</b> Bismuth 208.98038	84 <b>Po</b> Polonium (209)	85 <b>At</b> Astatine (210)	86 <b>Rn</b> Radon (222)
87 <b>Fr</b> Francium (223)	88 <b>Ra</b> Radium (226)	89 <b>Ac</b> Actinium (227)	104 <b>Rf</b> Rutherfordium (261)	105 <b>Db</b> Dubnium (262)	106 <b>Sg</b> Seaborgium (263)	107 <b>Bh</b> Bohrium (262)	108 <b>Hs</b> Hassium (265)	109 <b>Mt</b> Meitnerium (266)	110 <b></b>  (269)	111 <b></b>  (272)	112 <b></b>  (277)	113 <b></b>  (277)	114 <b></b>  (277)				